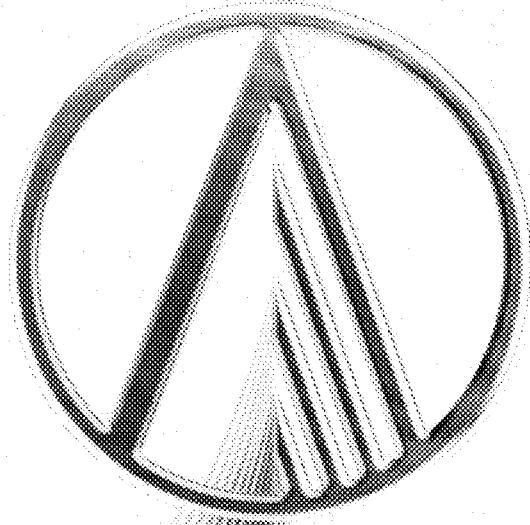
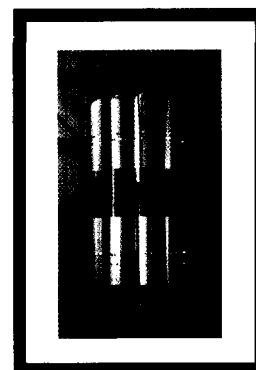
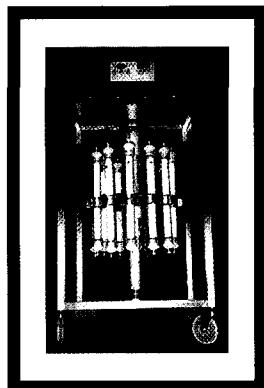
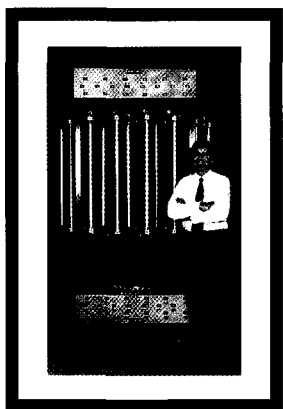


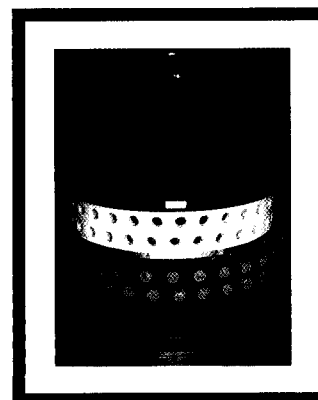
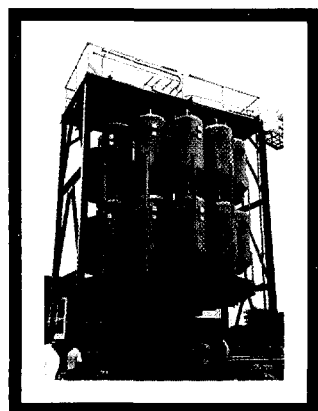
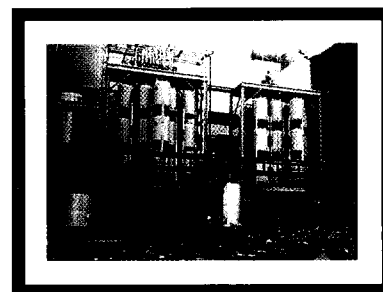
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ADVANCED SEPARATION  
TECHNOLOGIES INCORPORATED™



## ON THE CUTTING EDGE OF SEPARATIONS...



## ADVANCED SEPARATION TECHNOLOGIES

Separation technologies using adsorbents such as activated carbon and molecular sieves for the separation of organic compounds in a wide range of environmental and industrial applications. In many years the separation systems have been limited to the lack of a truly continuous process. A clear need exists for a continuous process where process and product syntheses could be carried out in the same manner as distillation or other separation approaches.

For any adsorption process:

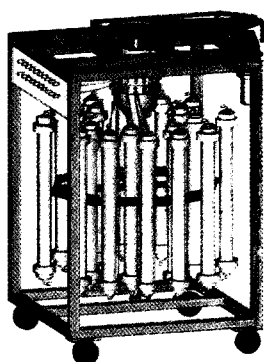
- **Substantial reductions in capital cost** - Reductions of up to 50% compared to conventional fixed bed systems.
- **Reduced regeneration energy usage** - Eluent flow rates less than one are required for continuous flow.
- **High productivity** - High throughput and water usage.
- **High recovery** - High recovery of flows and recovery of complete recovery.
- **Steady state operation** - No interruption of effluent stream.



---

## The Idea

Separation technologies employing solid sorbents such as ion exchange resin, activated carbon and molecular sieves accomplish useful separations in a number of industrial, analytical and environmental applications. Unfortunately, for many years the full potential of sorption-type separation systems could not be realized due to the lack of a truly continuous process. A clear need existed for a continuous process sorption system where process assessments and syntheses could be carried out in the same manner as solvent extraction, distillation or other established separation approaches.



Under a program sponsored by Florida Progress Corporation, development began in the mid-1980's for a truly continuous ion exchange technology. Out of that development, the ISEP® (Ionic SEPARation) Contactor was developed. Processes were developed utilizing the ISEP® unit as the cornerstone component.

AST has received several equipment patents related to the mechanical aspects of the ISEP® system, as well as process patents. AST continues to identify existing and emerging process applications where continuous separation systems can help the user achieve a more economical separation.

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## Technology Benefits

For any adsorption/desorption application, the Continuous Separator has the flexibility to achieve the following:

- **Substantial reduction in sorbent inventory** - Reductions of 30% to 90% are possible as compared to conventional fixed bed or pulsed bed systems.
- **Reduced regenerate (eluant) and water usage** - Eluant-to-resin volume ratios of less than one are achieved due to counter-current flow.
- **High product concentration** - Low eluant and water usage translate into less dilution.
- **High recovery** - Use of counter-current flows and recycling can provide essentially complete recovery.
- **Steady state/continuous operation** - There is no interruption of feed or regenerant stream flows and effluent streams are consistent in composition.
- **Simple operation & control** - No complex valve nests are used. Only two moving parts in entire system (distributor and turntable) with a rotation rate of 0.1 to 1 revolution per hour.
- **Flexibility** - The system allows for a number of user functions to be simultaneously achieved within a dynamic process stream under continuous operating conditions.
- **Capital and operating costs reduction** - Overall capital cost reductions of 30% to 50%, and operating cost reductions of 40% to 50% as compared to conventional fixed bed or pulsed bed systems.
- **Good tolerance for suspended solids** - Processes with high suspended solids can be entertained with more frequent backwash intervals.

# Continuous Separator Technology

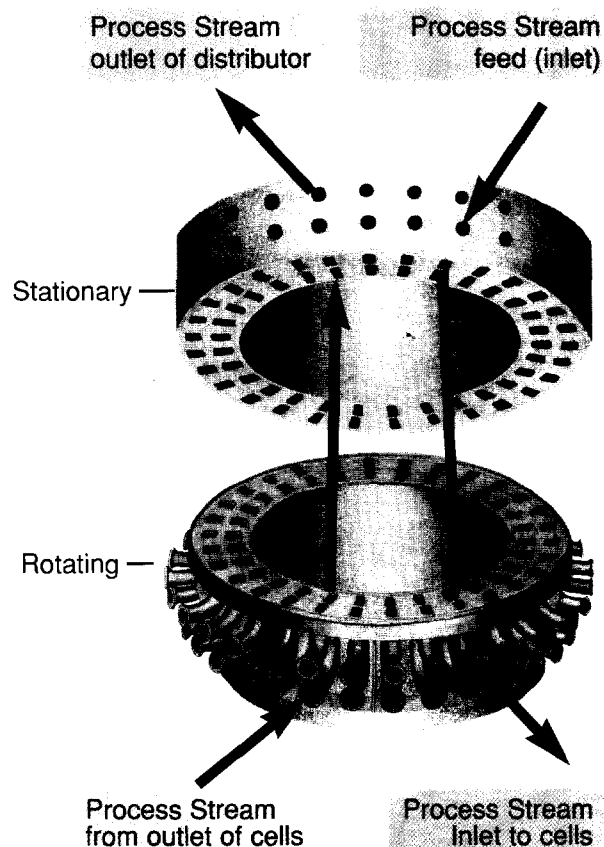
At the heart of the system is a single, multi-port, rotating distributor containing 12, 20 or 30 inlet and outlet ports. The distributor rotates at a specified rate using only one moving part. The stationary portion of the distributor manages and directs all incoming and out-going fluid streams into the appropriate zones and ports of the rotating portion of the distributor.

The rotating portion of the distributor draws process fluid streams from the stationary component and feeds the cells containing sorbent media. The media can be ion exchange resins, silica gels, activated carbon, molecular sieves, etc. The cells are mounted on a turntable that rotates along with the distributor.

During a 360 degree rotation, each resin cell is subjected to an entire sorption cycle. This cycle usually consists of adsorption, regeneration or elution, and one or two rinse steps. Additional steps may be provided depending on the process complexity.

The use of short beds allows for maximum resin utilization. None of the resin sits idle in the cells regardless of resin state - exhausted or regenerated. This feature results in a much lower resin inventory than would be the case for a conventional ion

exchange system. Counter-current regeneration and countercurrent rinse water flow, along with low resin volume, combine to reduce the amount of chemicals and diluent required to regenerate and clean the resin.



## Equipment Specifications And Capacities

<b>Port Sizes</b> .....	1/8 inch to 4 inches 3mm to 100mm
<b>Number of Ports</b> .....	12 to 30
<b>Flow Rates</b> .....	5 ml/min to 1,200 m <sup>3</sup> /hr
<b>Operating Pressure</b> .....	100 psi/6.9 bar max. Mini-CSEP® to 500 psi/34.5 bar
<b>Operating Temperature</b> .....	35°F to 230°F 2°C to 110°C
<b>Resin Volume</b> .....	1 liter to 300m <sup>3</sup>

**Materials of Construction** - Wetted parts of the distributor generally consist of two materials - an alloy head and a polymer head. Options include, but are not limited to:

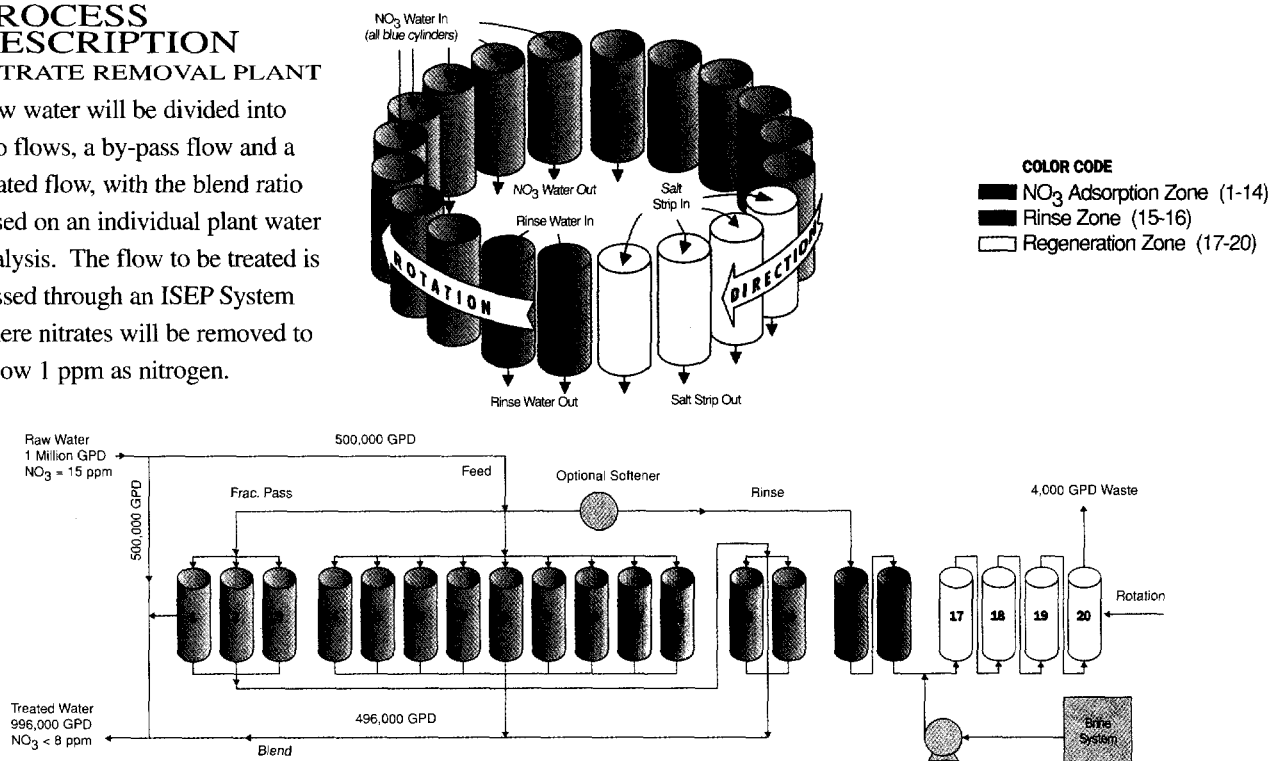
- **Stationary Head** - Polypropylene, polyethylene, PVDF and PTFE
- **Rotating Head** - 316SS, Alloy 20, PEEK and Hastelloy C
- **Cells** - Resin chambers can be constructed from a variety of materials to suit the application. The chambers contain top and bottom retention screens to allow upflow and downflow in any of the zones.

# Typical ISEP Process

## PROCESS DESCRIPTION

### NITRATE REMOVAL PLANT

Raw water will be divided into two flows, a by-pass flow and a treated flow, with the blend ratio based on an individual plant water analysis. The flow to be treated is passed through an ISEP System where nitrates will be removed to below 1 ppm as nitrogen.



### ADSORPTION ZONE

The adsorption zone has 14 ports in parallel for single pass flow where the nitrate will be removed. Since the rotation of the ISEP valve is from the right to the left on the diagram, cells 1-3 will become increasingly loaded with nitrate. To prevent any possibility of leakage of  $\text{NO}_3$ , the treated water from cells 1-3 is passed through two freshly regenerated ports 13 and 14. This

is a safeguard against nitrate dumping as can occur in conventional fixed bed units.

### STRIP WASH ZONE

A small amount of pre-softened feed-water is used to strip wash cells 15 and 16 after which it will be used to dilute the 24% brine solution used for regeneration. This two-pass countercurrent configuration is most effective in preventing salt from regeneration being

transferred into the product water.

The softening process prevents the possibility of calcium sulfate precipitating in the resin bed.

### REGENERATION ZONE

The combination brine and strip wash (8%  $\text{NaCl}$ ) is directed through cells 17-20 for true countercurrent regeneration for maximum regeneration efficiency and solids removal from the resin bed.

## Modes of Operation

The Continuous Separator offers a variety of operating techniques. These techniques are defined as modes of operation within each functional zone.

- **Parallel Flow**- Ports are manifolded together for single contact. Useful for high flow rates, high mass transfer rates and lower recovery requirements.
- **Parallel Flow w/Upflow** - Important in applications with high suspended solids.
- **Series Flow** - Employs multiple lengths of cells when mass transfer zone is

longer than a single cell height. Also used in stripping or regeneration to maximize effluent concentrations.

- **2-Pass Series Flow** - Combination of parallel and series flow. Used for large volumes requiring complete removal.
- **Recirculating Flow** - Used in stripping when fast fluid velocity is needed.

# Advanced Separation Technologies, Inc.

Advanced Separation Technologies, Inc. (AST) is a leading worldwide supplier of continuous process purification and separation equipment to industry. Located in Lakeland, Florida, AST was incorporated in January, 1986.

The mission of AST is to market a unique and cost effective process technology that can be applied to the purification/separation of fluid streams on an industrial scale.

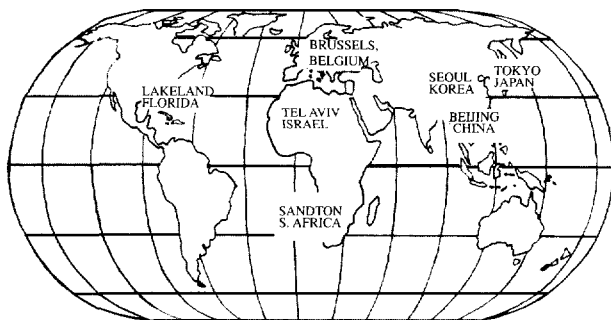
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## AST Capabilities

AST maintains 35,000 square feet of corporate office space and facilities in Lakeland, Florida. Available services include...

- Full process engineering design support to match customer applications to the continuous separator.
- Pilot testing at the AST headquarters location or at the customer site for performance evaluation.
- Analytical laboratory for bench, scale-up and pilot support.
- Project management for full turnkey support that includes installation, startup and operational assistance.

### TECHNICAL SERVICE CENTERS



# Applications

## Biotech/Pharmaceutical Industry

- Antibiotic Purification
- Vitamin Recovery
- Optical Isomer Fractionation

## Fermentation

- Purification of Broth
- Decolorizing Solutions
- Cation Removal
- Softening

## Food Processing Industry

- Fructose Enrichment
- Impurities Removal
- Decolorization Processes
- Deashing
- Protein Fractionations

## Hydrometallurgy Industry

- Selective Metals Separation
- Strategic Metals Recovery
- Metals Concentration from Leach Liquors

## Inorganic Chemicals Industry

- Potassium Salts
- Advanced Fertilizer Production
- Brine Purification
- High-Purity Chemical Salts
- Acid Decolorization

## Organic Chemicals Industry

- Petrochemicals Production
- Decolorization Processes
- Water Purification
- P-Xylene Purification

## Pulp and Paper Industry

- Effluent Decolorization

## Sugar Industry

- Decolorizing
- Deashing
- Cation Removal
- Purification of Syrups
- Ion Exclusion

## Wastewater Industry

- Municipal
- Industrial

## Water Treatment Industry

- Desalination - Pretreatment
- Demineralization - Ion Removal

# CONTINUOUS ION EXCHANGE SEPARATIONS

# ISEP<sup>®</sup> SYSTEM

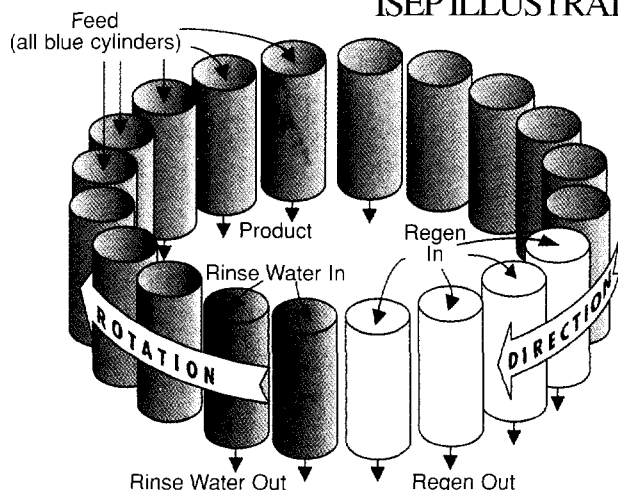
Advanced Separation Technologies has developed and commercialized an ISEP<sup>®</sup> Continuous Separator to perform ideal ion exchange separations using counter-current processing. The ISEP<sup>®</sup> Continuous Separator system features a turntable containing 12, 20 or 30 resin chambers. The turntable rotates at a constant speed and moves the resin chambers with it, as they cycle continuously through the various separation phases. The ISEP<sup>®</sup> system directs the fluids through the resin chambers and delivers product continuously.

Conventional Ion Exchange fixed-bed adsorption

systems are usually employed in processes that require the removal of dilute concentrations of chemical species. The low concentrations permit beds of practical size to remain in service for relatively long periods of time, typically 4 to 24 hours. The major disadvantages of fixed-bed sorption systems are the inefficient utilization of sorbent, their high volume consumption of chemicals and their limited applicability due to the constraint of low-feed concentration.

The ISEP<sup>®</sup> Continuous Separator provides a new dimension in design flexibility that addresses some of the more serious disadvantages of fixed-bed industrial separators.

ISEP ILLUSTRATION



## ISEP DESIGN FEATURES

- CONFIGURATION FLEXIBILITY
- REDUCED RESIN INVENTORY
- SIMPLIFIED CONTROL PHILOSOPHY
- REDUCED REGENERATION CHEMICALS
- STEADY STATE OPERATION

# DESIGN FEATURES

**CONFIGURATION FLEXIBILITY** - The ISEP® system allows for a number of unit functions to be simultaneously achieved within a dynamic process stream under continuous operating conditions. Complex processes requiring multiple eluent and regeneration streams are easily accomplished with the ISEP® system.

**REDUCED RESIN INVENTORY** - Sorbent inventory reductions of 30 to 90% are possible due to minimization of idle resin. The use of short resin beds allows for maximum resin utilization. None of the resin sits idle in the cells either in its exhausted or regenerated state.

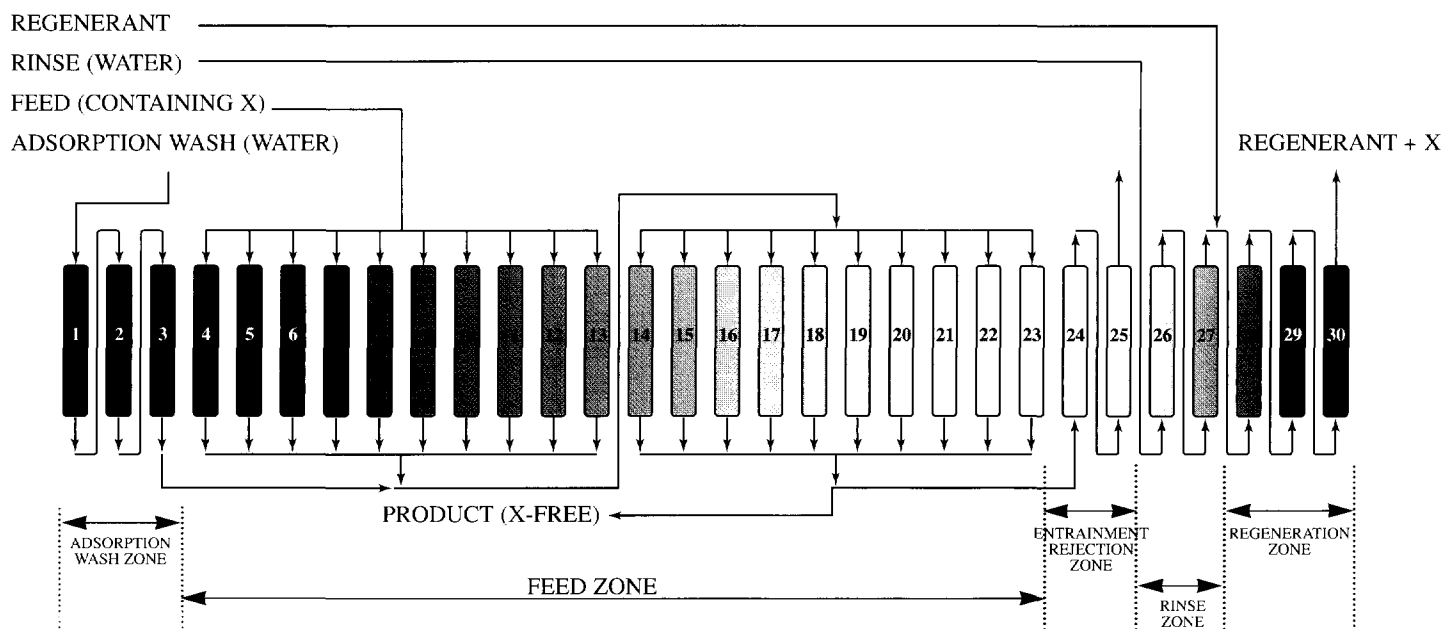
**SIMPLIFIED CONTROL PHILOSOPHY** - The ISEP® eliminates all complex sequencing of high maintenance on/off valves. This feature reduces the maintenance and makes the system easy-to-operate.

## REDUCED REGENERATION CHEMICALS -

Regenerant/resin volume ratios of less than one are achieved due to counter-current flow through short sorbent beds leading to higher used regenerant concentrations and smaller effluent volumes. Counter-current regenerant and rinse water flows with low-volume resin cells combine to reduce the amount of chemicals and dilution required to regenerate and clean the resin.

**STEADY STATE OPERATION** - There is no interruption of feed or regenerant stream flows, and effluent streams are consistent in composition.

## CONTINUOUS ION-EXCHANGE EXAMPLE - WITH PARALLEL AND SERIES FEED



1. **ADSORPTION WASH ZONE** - Wash water is injected into three resin beds in series to recover feed and product and is combined with outlet of first pass and fed to second pass.
2. **FEED ZONE** - Feed containing product and ion to be removed feeds 10 ion exchange beds in parallel followed by a second pass through 10 additional beds. This arrangement allows high flow rates with extended contact time counter-current, double pass provides high product quality.
3. **ENTRAINMENT REJECTION ZONE** - Product is collected after second pass minus undesirable ion. A portion of the product is fed into entrainment rejection zone to displace rinse water and reduce dilution.
4. **RINSE ZONE** - Rinse water is injected to rinse chemical regenerant from resin. Two resin beds in series are used in this zone.
5. **REGENERATION ZONE** - Chemical regenerant is fed into three resin beds in series. This allows maximum chemical utilization and excellent resin regeneration.

ADVANCED SEPARATION TECHNOLOGIES INC.  
5315 GREAT OAK DRIVE, LAKELAND, FLORIDA 33815  
PHONE: 941-687-4460 FAX: 941-687-9362  
E-MAIL: AST@advsep.com

**ADVANCED SEPARATION TECHNOLOGIES INC**



## **Continuous Adsorption Ion Exchange Systems**

**The ISEP® System  
For Water Treatment**

- Nitrate Removal
- TDS Reduction
- ION Selective Impurity Removal

# Eliminate Your Nitrate Problems

## Who Recommends ION Exchange... The EPA

"The ion exchange process is generally more suitable as a well site treatment for  $\text{NO}_3$  removal than R.O. or a combination of the two. Ion exchange requires lower capital cost and annual operating costs, has greater reliability, uses less energy, requires no additional well site storage, has higher water recovery, produces more concentrated waste brine and requires fewer automatic and electric controls. It can be operated on demand as required. Such on/off operation is more detrimental to an R.O. system which operates best on continuous basis."

EPA-600/S2-82-042

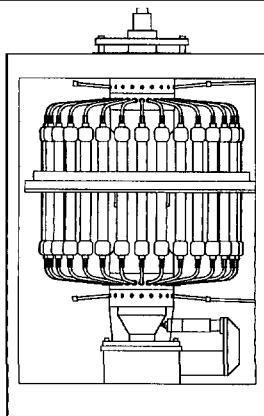
### With The ISEP Continuous Ion Exchange System

**Your most efficient and cost effective method of ion exchange for Nitrate removal.**

- **Up to 90% less waste**
- **Low capital and O&M costs**
- **Simplicity of operation**
- **Highly efficient and reliable**
- **Maximum  $\text{NO}_3$  removal**

## A Truly Continuous Ion Exchange System

The ISEP Contactor utilizes a number of ion exchange beds (usually 30) which are mounted on a slowly rotating carousel. The rotation of the carousel moves the beds slowly through the required sequence of operations which normally includes adsorption, backwash, regeneration and rinse. These operations are going on simultaneously as the carousel rotates. The different fluids are distributed through an upper and lower valve with 20 ports allowing for either concurrent or countercurrent flow through the resin beds



depending on the requirement.

This arrangement allows for each of the 20 ports to have one or more cells as an outlet so that flow is always continuous.

Rotation is provided by a fractional horsepower motor with low energy consumption. Essentially, there is only one moving part to the ISEP which typically turns 2-6 times a day. Valves are limited to 5 or 6, unlike fixed bed systems requiring 30 or more valves.

# Why ISEP Is Your Best Solution To Nitrate Problems

## Simple Reliable Continuous Operation

- Ideal for Start/Stop Operation
- Operates at Line Pressure

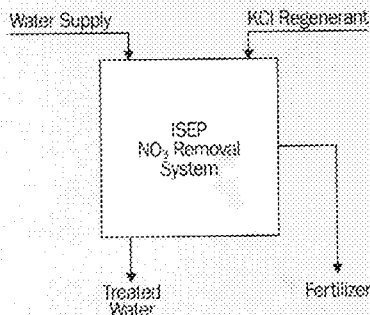
## Flexibility

- Handles Fluctuations in Flow and/or Nitrates by Adjusting Rotation
- Modular Design Allows for Future Expansion

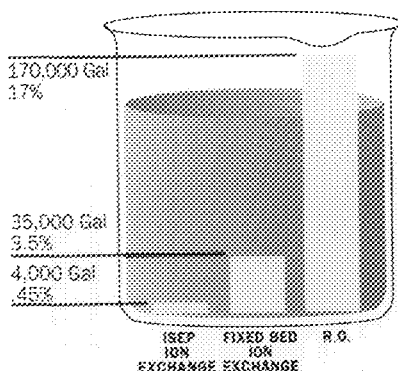
## ISEP Turns Waste Into Fertilizer

By changing your regenerant from NaCl (salt) to KCl, the ISEP is unique in producing a concentrated fertilizer solution that can be marketed to the agricultural community. The KCl replaces the salt on a 1:1 basis and can be alternated with salt depending on the growing season.

## ISEP NO<sub>3</sub> REMOVAL



## WATER USAGE

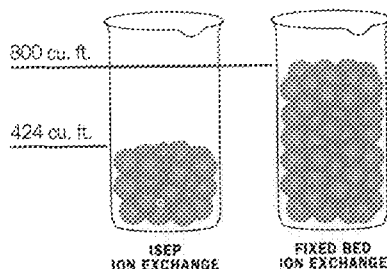


For Million Gallons Treated

## Maximum Water Utilization

- Up to 90% Reduction in Waste
- Increased Water Capacity
- ISEP Can Turn Waste into Fertilizer

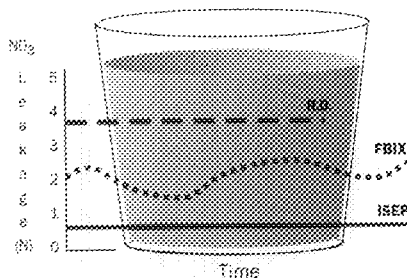
## RESIN USAGE



## Maximum Treatment Efficiency

- Up to 60% Less Resin
- Countercurrent Regeneration
- Fractional Bypass Eliminates the Chance of Nitrate Dumping

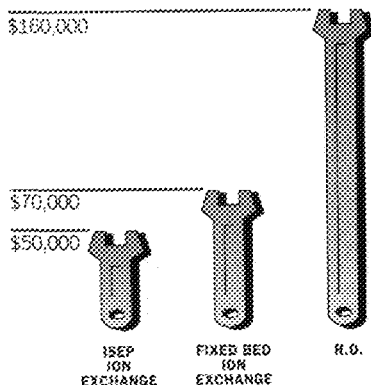
## NO<sub>3</sub> IN TREATED WATER



## Consistent Water Quality

- Continuous Operation Eliminates Fluctuations in NO<sub>3</sub> levels

## OPERATION AND MAINTENANCE

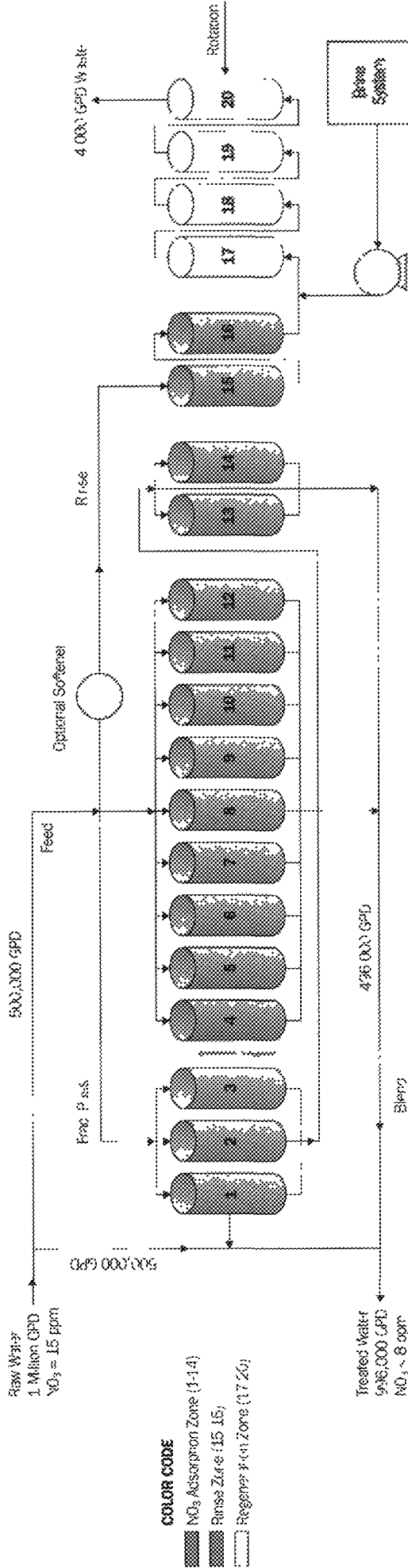
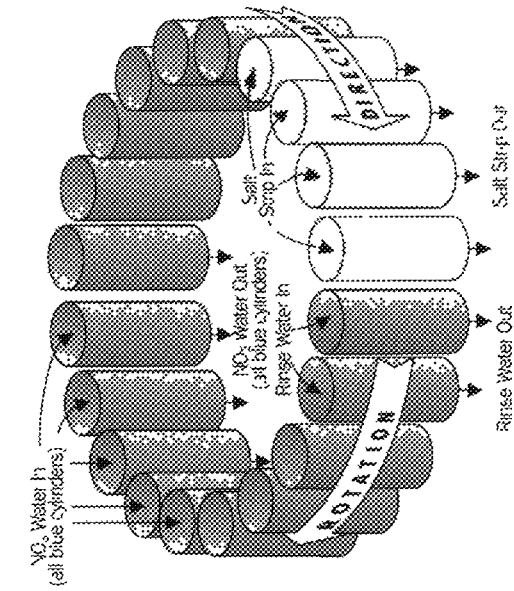


1 MGD Plant

## Low Operation And Maintenance Costs

- ISEP Operates on Fractional H.P. Motor
- Only One Moving Part - 75% Less Valves
- Easy to Operate and Maintain

# ISEP Nitrate Removal System



## Process Description

Raw water will be divided into two flows, a by-pass flow and a treated flow, with the blend ratio based on an individual plant water analysis. The flow to be treated is passed through an ISEP System where nitrates will be removed to below 1 ppm as nitrogen.

## Nitrate Adsorption Zone

The adsorption zone has 14 pores in parallel for single pass flow where the nitrate will be removed. Since the location of the ISEP valve is from the right to the left on the diagram, cells 1-3 will become increasingly loaded with nitrate. To prevent any possibility of leakage of  $\text{NO}_3$ , the treated water from cells 1-3 is passed through two freshly regenerated pores 13 and 14. This is a safeguard against nitrate dumping as can occur in conventional fixed bed units.

## Strip Wash Zone

A small amount of pre-softened feed-water is used to strip wash cells 15 and 16 after which it will be used to dilute the 24% brine solution used for regeneration. This two-pass counter-current configuration is most effective in preventing salt from regeneration being transferred into the product water. The softening process prevents the possibility of calcium sulfate precipitating in the resin bed.

## Regeneration Zone

The combination brine and strip wash (8%  $\text{NaCl}$ ) is directed through cells 17-20 for true countercurrent regeneration for maximum regeneration efficiency and solids removal from the resin bed.

## Process Control And Instrumentation

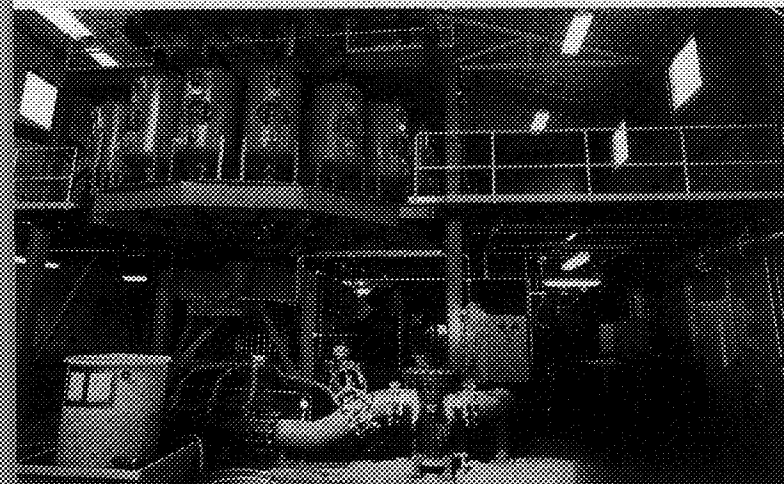
The ISEP readily adapts to a fully automated system, the heart of which is a small Programmable Logic Controller (PLC) which controls the ISEP, blend ratio and operation of the booster pumps if required. In most cases, an automated nitrate monitoring system is installed at the inlet and outlet to record nitrate levels.

# Wisconsin City Chooses The ISEP Nitrate Removal System

Designed to handle flows of 4.55 million gallons per day with nitrate levels in excess of 15 ppm (as N).

The ISEP is achieving its design objective:

- < .4% waste based on raw water flow
- Minimal salt consumption
- High degree of flexibility
- Reliable and economical operation



## ACTUAL COMPARISON WITH OTHER NITRATE REMOVAL METHODS

	ISEP	OTHER ION EXCHANGE	REVERSE OSMOSIS
Product Availability/Yr	364.5M GAL	359M GAL	301.1M GAL
Waste Generated/Yr	474,500 GAL	6,000,000 GAL	52,700,000 GAL
Waste/Flow Percent	0.16%	1.6%	17.5%
Resin Volume	420 FT <sup>3</sup>	800 FT <sup>3</sup>	N/A
Cost/Million Gallons	\$137.44	\$192.78	\$438.36
Chemical Usage/Yr	\$26,000	\$27-33,000	\$3,600
O&M Costs/Yr	\$30,000	\$70,000	\$160,000
Capital Costs	\$1.4M* *ISEP design for 4.55 MGD	\$1.4M	\$4.5M
Reliability	Excellent	Good	Requires Factory Service
NO <sub>3</sub> Leakage in Treated Water (N)	<1 mg/L	1-2 mg/L	2-3 mg/L
Operator Safety	Excellent	Excellent	Precautions Required

Results based on a midwest city pumping 1 MGD and NO<sub>3</sub> levels of 15 ppm (N).

# Other ISEP Water Applications

## Treatment Of Brackish Water

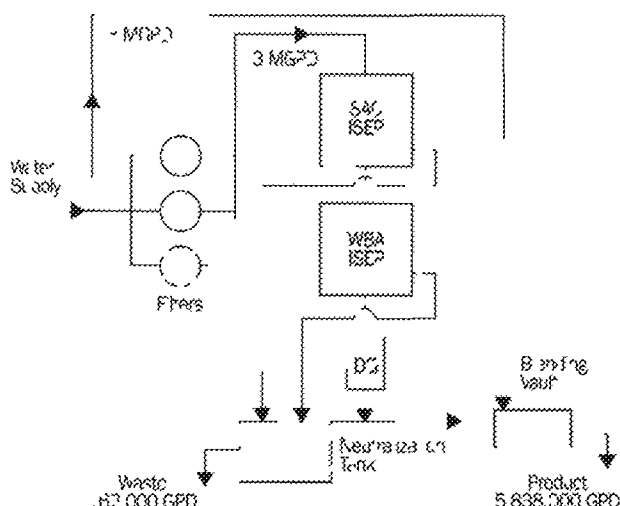
### Application: TDS Reduction

Where raw water TDS < 1250, the ISEP Demineralizer System is economically competitive with R.O.

#### Advantages:

- Lowering percent waste from 20 to 5-6% of raw water flow
- Increased water capacity
- Low O&M costs
- High degree of flexibility

## ISEP DEMINERALIZATION SYSTEM



SAC Strong Acid Cation Resin WBA Weak Acid Base Anion Resin Oil Degreaser (Oil Removal)

## Nitrate Polishing System

### Application: NO<sub>3</sub> Polishing for Existing

R.O. Plants

Increases raw water blend ratio where NO<sub>3</sub> is the limiting factor.

#### Advantages:

- Increases plant capacity
- The ISEP removes NO<sub>3</sub> from raw water more economically
- With less waste than expanding R.O.

## Selective Ion Removal

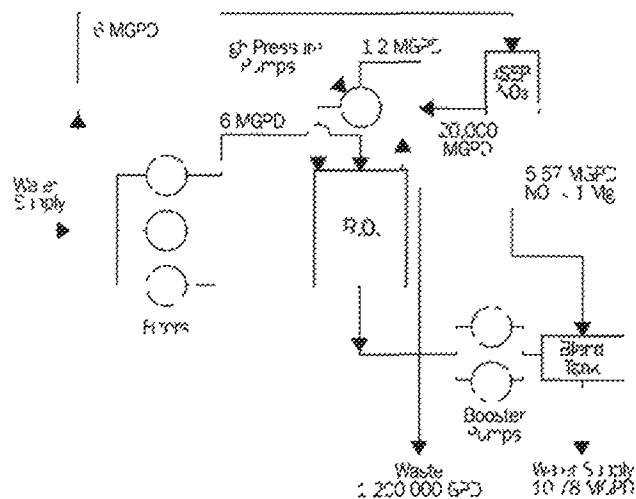
Application: Eliminating the following impurities from drinking water

- |            |           |               |
|------------|-----------|---------------|
| • Lead     | • Copper  | • Mercury     |
| • Iron     | • Calcium | • Magnesium   |
| • Fluoride | • Sulfate | • Sulfide     |
| • Chloride | • Nitrate | • Bicarbonate |

#### Advantages:

- Small concentrated waste streams for easy disposal
- Simple & easy to operate
- Low capital and O&M costs

## ISEP NO<sub>3</sub> POLISHING SYSTEM



### **The Company**

Advanced Separation Technologies, headquartered in Lakeland, Florida was formed in 1986 to market the patented ISEP Continuous Ion Exchange technology. AST is a wholly owned subsidiary of Calgon Carbon Corporation, a world leader in activated carbon and related separation and purification technologies.

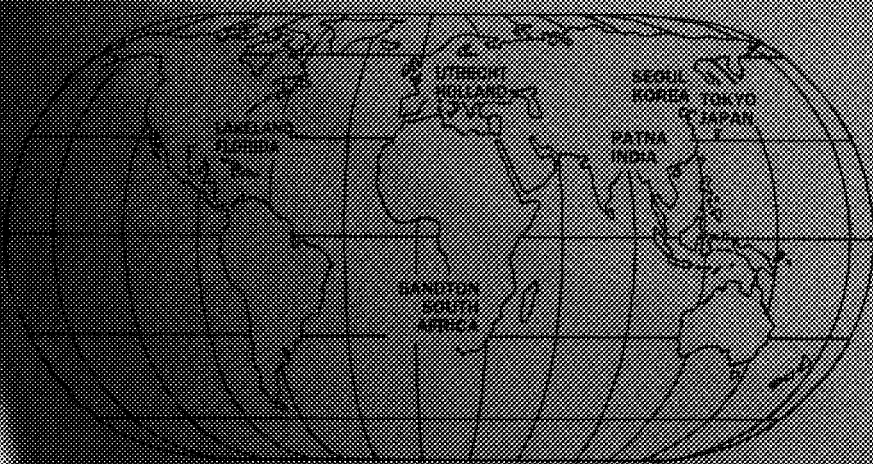
### **Resources**

AST maintains a 35,000 sq. ft. facility in the Lakeland Regional Industrial Park complete with the following facilities:

- Licensed Analytical Laboratory
- Process Testing and Pilot Plant Facilities
- Engineering and Design
- Technical Support Group
- Fabrication and Assembly
- Project and Construction Management Capabilities

### **Service**

AST can provide installation, start-up, operator training, and a maintenance contract from its worldwide service group. Once your ISEP units are operating, continued operational and technical service is always available when you need it.



**ADVANCED SEPARATION TECHNOLOGIES INC.**

2215 Green Oak Drive • Lakeland, FL 33801

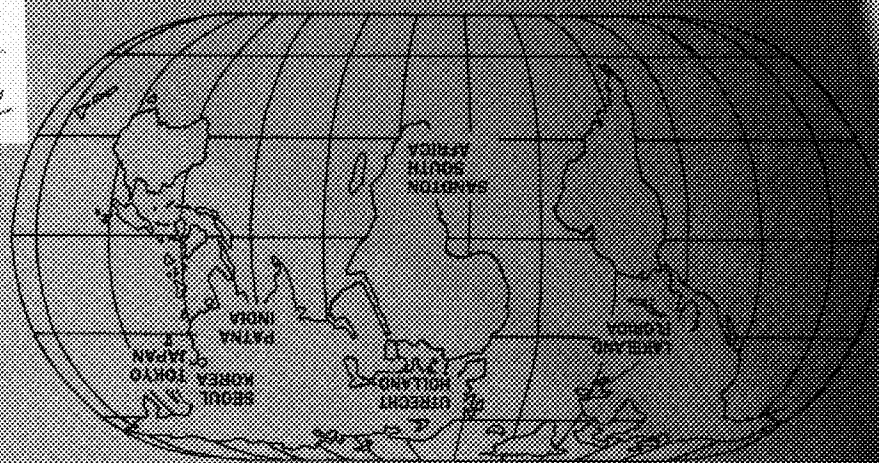
Phone (813) 721-4660 • FAX (813) 727-9362

Advanced Separation Technologies, headquartered in Lakeland, Florida was formed in 1986 to market the patented ISEF Continuous Ion Exchange technology. AST is a wholly owned subsidiary of Calgon Carbon Corporation, a world leader in activated carbon and related separation and purification technologies.

As I maintains a 35,000 sq. ft. facility in the Lakeland Regional Industrial Park complete with the following facilities:

- 000000

As I can provide installation, start-up, operator training, and a maintenance contract from its worldwide service group. Once your ESH units are operating, continued operational and technical service is always available when you need it.



ADVANCED SEPARATION TECHNOLOGIES INC

$\text{P}(\text{NVI}) = \frac{\text{P}(\text{NVI}|\text{NVI}) + \text{P}(\text{NVI}|\text{NVI})}{\text{P}(\text{NVI}|\text{NVI}) + \text{P}(\text{NVI}|\text{NVI})}$

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## Continuous Ion Exchange Helps Smaller Towns Meet Nitrate Level Water Standards

**R**emoving nitrates from potable water supplies can be a challenge, both for large and small communities. Federal Safe Water nitrate regulations make no distinction between a community's size and its ability to pay the cost of compliance.

A continuous ion exchange separator has offered a satisfactory solution for five rural water utilities over a three year span. The utilities are Downs, Kans.; Clear Lake and Ellsworth, Minn.; Lake Moreno Village, Campo, Calif.; and Plover, Wis.

Federal Safe Water regulations limit nitrate content in public water to 10 ppm. A continuous ion exchange system from Advanced Separation Technologies Inc. has proven it will do the job efficiently and cost effectively.

In operation, a carousel arrangement of 30 fixed-bed columns slowly rotates between upper and lower stationary ports. The columns sequentially receive the water to complete a four-phase cycle: separation of the nitrates, media wash, media recovery and media rinse.

In these five communities, the nitrates were pulled out to a lower than required level, then blended with an incoming stream to reach acceptable final levels. The system regenerated the media in place, requiring only the two moving parts. This split stream approach proved to be cost-efficient in keeping within EPA limits.

Over a half dozen ISEP nitrate removal units are operating nationally, with another similar amount under consideration. To follow are summaries of five more recent jobs.

Delivering 877,000 gpd at maximum levels, the utility in Downs had nitrate levels in untreated water at 12 to 13 ppm. Treated water was two ppm, blended to eight ppm. City consultants originally studied alternative solutions including ion exchange, reverse osmosis, electrodialysis and

nanofiltration. Eventually, the choice narrowed to two types of ion exchange, fixed-bed or continuous.

Though initial cost for the continuous method was higher, ten year projections of operation and maintenance showed a lower ownership figure overall. The city water plant is currently producing a blended water product meeting the nitrate action levels in compliance with EPA regulations.

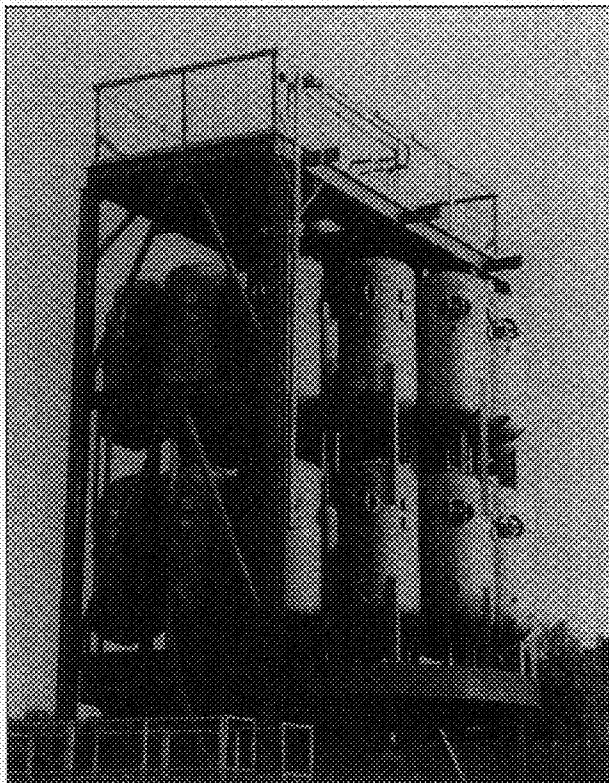
Starting up in January 1996, the Clear Lake utility had a nitrate content from city water sources of 12 to 15 ppm before installation.

The AST continuous ion exchange unit reduced the level to 2 ppm in a split stream, that was then blended with incoming water until it reached 8.5 ppm.

This proved more efficient than separating the entire water stream, so long as nitrate levels never exceeded acceptable content. Blending was a standard practice.

The Ellsworth utility processes 105,000 gpd. Nitrate content from feed water was 20 ppm. The ISEP system reduced it to less than 2.5 ppm and subsequent blending brought levels to an acceptable 8 ppm.

Lake Moreno Village selected the continuous ion exchange system because of significantly lower operating costs and less waste production, and because they had to haul their waste off. In-service experience showed a 99.5 percent water utiliza-



Continuous ion exchange system.

tion efficiency and a 0.3 percent waste. Nitrate levels were in the 12 to 15 ppm range and were reduced to 2.5 ppm and then blended to the 8 ppm level.

Lastly, the Plover facilities system had the capacity to produce over 4,500,000 gpd of <5 ppm of N water. It was a completely computerized system that required no full time operators and only a daily spot check. The actual operating costs were running at \$0.053/1000 gallons. Nitrate levels in the untreated water ranged from 12 to 13 ppm with treated water at <2.5 ppm as N, with blending the product water running <5 ppm N.